Waste Erosion Assessment and Review (WEAR)

Final Report

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Solid Waste Program,

Alaska Department of Environmental Conservation

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Acronyms

ADCCED	Alaska Department of Commerce, Community, and Economic Development
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
BEA	Baseline Erosion Assessment
C&D	Construction and Demolition Debris
CIAP	Coastal Impact Assistance Program
CSP	Contaminated Sites Program
DAP	Detailed Action Plan
DCRA	Division of Community and Regional Affairs
DOD	US Department of Defense
FY	Fiscal Year
GIS	Geographic Information System
GPS	Global Positioning System
HHW	Household Hazardous Waste
IGAP	Indian General Assistance Program
IHS	Indian Health Service
MSW	Municipal Solid Waste
PCBs	Polychlorinated Biphenyls
PERP	Prevention and Emergency Response Program
SWIMS	Solid Waste Information Management System
SWP	Solid Waste Program
USACE	US Army Corps of Engineers
USCS	Unified Soil Classification System
USFWS	US Fish and Wildlife Service
WEAR	Waste Erosion Assessment and Review
WWII	World War II

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The SWP recognizes the efforts of ADEC's Contaminated Sites Program, and former staff in the Solid Waste Program, in the planning of this project, as well as participation in some of the WEAR inspection trips.

Finally, the SWP specifically recognizes our core project team, who have spent many hours, and travelled thousands of miles to gather, organize, and analyze information to complete this project.

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Executive Summary

With funding from the federal Coastal Impact Assistance Program (CIAP), the Alaska Department of Environmental Conservation (ADEC) Solid Waste Program (SWP) conducted a four-year Waste Erosion Assessment and Review (WEAR) project to assess, inventory, and prioritize landfills, contaminated sites, and other sites of environmental concerns that may be at risk for eroding within rural Alaskan communities. A total of 716 individual sites in 124 communities were inspected as part of the WEAR project. Individual sites were assessed and ranked based on the potential for erosion and associated contaminant risks. Environmental factors including location, erosion types and symptoms, probable contaminants, and potential for human or environmental exposure were used to calculate an erosion risk and contaminant risk score for each site.

This report presents a summary of the WEAR project and the methodology for assessing and ranking site risk. For the sites identified as having both the highest risk of eroding and highest risk of potential contaminants, the SWP generated Detailed Action Plans (DAPs). The DAPs summarize the site-specific erosion and contaminant risks and provide options for potential corrective measures to mitigate these risks. The DAPs can be used as supporting documentation by communities seeking funding to address the risks associated with these sites, and can be found in Appendix B of this report.

The project also allowed the SWP to conduct landfill evaluations in each community visited. The landfills were assessed in regard to location, overall operations, and handling of special wastes. The landfill evaluations provided an opportunity to offer technical assistance to the community regarding landfill improvements for the protection of human health and the environment.

Data collected for the WEAR project was entered into the ADEC SWP's Solid Waste Information Management System (SWIMS) database and is available to the public on the ADEC SWP website at: http://dec.alaska.gov/eh/sw/. Preliminary Reports for each community were prepared after each field season to provide a summary of the WEAR site inspections, and are included in Appendix A.

I. Background

The CIAP provides federal grant funding derived from federal offshore oil and gas lease revenues. Alaska is one of six states eligible to receive this funding. The funding must be used for conservation, protection, restoration, mitigation, planning, and implementation of plans related to impacts of outer Continental Shelf oil and gas industry activities. The United States Fish and Wildlife Service administers the CIAP at the Federal level, and the Alaska Department of Natural Resources (ADNR) Office of Project Management and Permitting is the designated Alaska state agency for the CIAP.

ADEC was awarded the CIAP grant for the WEAR project and work began in 2011. The WEAR project's purpose was to develop an inventory of landfills, contaminated sites, and other sites of environmental concern (tank farms, city shops, waste staging areas, etc.) that are at risk of eroding and releasing hazardous substances and debris into marine and riverine environments. The project area included Alaska's northern and western coasts, the Aleutian Islands, and river communities up to 300 miles upriver from the coast. Once sites were identified within each community, the sites were evaluated and ranked according to potential erosion risk and contaminant risk. From this ranking, the list of sites requiring DAPs (Table 2) was determined. Additionally, the WEAR project included an evaluation of each active landfill in the project area communities, regardless of whether the landfill is at risk of erosion.

Reasons for Concern

Coastal and river erosion are natural processes that occur due to material being worn away by a variety of energy sources, such as water flow, wave action, ice gouging/scouring, and wind. Coastal and river erosion have been reported to have accelerated in some areas in Alaska. Climate change has been identified as one factor in this acceleration.

The acceleration in coastal and river erosion is increasing the potential for erosion-caused releases of hazardous substances and debris from landfills, contaminated sites, and other sites of environmental concern. As temperatures have risen, historically frozen subsoil, or permafrost, has begun to thaw, compromising the stability of the soils and allowing the possible release of once-encapsulated contamination to the environment. Coastal communities are

Figure 1. Nunam Iqua - Shoreline Erosion 2014

impacted as thinner and later-forming sea ice provides less protection from fall and winter storms surges.

Contaminants of environmental concern can be the result of historic site activities and waste disposal practices at now-abandoned sites. During World War II (WWII), remote Alaska became the United States' first line of defense as Japan occupied the western islands of the Aleutians (Kiska and Attu). WWII projects were built to defend the nation in remote areas of Alaska. Alaska had further military buildup during the Cold War, when military communications and radar stations were constructed in many remote areas. Former Department of Defense (DOD) occupation of these strategic Alaskan outposts during times of war left both debris from old infrastructure and hazardous wastes, such as polychlorinated biphenyls (PCBs), chlorinated solvents, and petroleum from leaking fuel tank farms. Past industrial waste management practices have also contributed to the concern. In the mid-1900s, the oil and gas industry came to Alaska. During the early years, industry waste regulations and oversight were limited, and waste from oil and gas activities were disposed of with little consideration of impacts to the environment. Mining in Alaska predates the oil and gas industry. Many mines were simply abandoned leaving their waste and infrastructure behind. State and federal agencies are now addressing the cleanup of many of these historic contaminated sites.

All community infrastructure, including homes, schools, landfills, tank farms, are centralized around the limited transportation network within the community. Many communities lack basic services, including piped water and sewer, and the necessary resources to operate and maintain the landfill or other utilities properly, which may pose an environmental health concern. The residents' close proximity increases the potential for exposure.

Figure 2. Russian Mission - Cargo Delivery 2012

All of the communities in the project are only accessible by boat or airplane. Barges bring in most supplies during the short ice-free periods each year. Community infrastructure is often situated near the barge landing and adjacent to wetlands, rivers, or shorelines, making them susceptible to erosion. Contaminants from eroding sites can impact Alaska's waters, wetlands and sensitive marine environments. Debris from eroding sites can also pose safety hazards for navigation, wildlife, and birds.

ADEC’s Role

ADECs mission is to conserve, improve, and protect Alaska's natural resources and environment to enhance the health, safety, economic and social well-being of Alaskans. This includes addressing possible sources of contamination and understanding the potential impacts of erosion at these sites.

The ADEC SWP regulates landfills throughout Alaska and stores information on active and closed landfills in the SWIMS database, including landfill location and design information, permit status, inspection results, and other pertinent information for known landfills. However, for rural landfills some of the details were incomplete. WEAR project inspections allowed for the collection of additional information for known waste disposal sites, as well as identifying locations for previously unknown waste disposal sites.

The ADEC Contaminated Sites Program (CSP) has worked with the DOD and other federal civilian agencies for decades to address current and former contamination related to military operations, as well as federal airports, schools, and transportation facilities. Over the years, the CSP has raised the issue of eroding landfills and had some success in developing an inventory of these sites and making plans for remediation. However, securing funding for mitigation efforts to address these sites has been difficult without being able to demonstrate risk.

The CSP maintains a database of contaminated sites throughout the state. As of May 2015, the database lists 2,251 sites as Open, 1,172 sites as Cleanup Complete with Institutional Controls, and 3,867 sites as Cleanup Complete. Alaska state law requires that all oil and hazardous substance releases to the environment be reported to ADEC, but ADEC has never had the resources to seek out sites for a comprehensive inventory. Therefore, voluntary reporting is the primary way new sites are identified by the program, and these sites are entered into the database if there is sufficient evidence of contamination. Management efforts since the early 1990s have focused on prioritizing known contaminated sites for clean-up efforts to best protect public health and the environment with limited staff time and funds.

ADEC SWP and CSP have both received reports of eroding sites that were potential sources of contamination. However, limited funding has been available to investigate some of these remote sites. The CIAP grant provided the funding to investigate these sites of environmental concern and evaluate potential erosion and contaminant risks.

Project Location

The WEAR project includes communities on Alaska's northern and western coasts, the Aleutian Islands, and up to 300 miles upriver from the coast. The coastal areas include the Aleutian Islands Boroughs, Lake and Peninsula Borough, Bristol Bay Borough, Kuskokwim Bay region, Bering Sea region, Norton Sound region, Kotzebue Sound region, and North Slope Borough. Island communities in the Bering Sea were inspected as well. Due to the limitation directing the grant to the impacts of outer continental shelf oil and gas industry activities, the project excluded communities in the interior, Southcentral, and the Gulf of Alaska, including Kodiak Island, and Southeast Alaska.

Figure 3. WEAR Community Map (ADEC SWP, 2015)

II. Pre-Field Project Work

Prior to sending inspectors to the field, ADEC work focused on more carefully defining the scope of the study presented in the project narrative, identifying the specific parameters of study, and developing field tools to be used for site inspections.

Desktop Evaluation

The initial step of the desktop evaluation was to determine which communities would potentially be included in the study. The CIAP effort focuses on mitigating the impacts of outer continental shelf oil and gas activities to coastal communities. As such, the WEAR project area was limited to coastal regions of Alaska along the Beaufort Sea, Chukchi Sea, and Bering Sea, which are areas where offshore lease sales had occurred, or were proposed to occur[1]. As a starting point, the WEAR project team (the team) determined the initial effort should include the western and northern coastal areas of Alaska from Kaktovik to Adak.

Using the Alaska Department of Commerce, Community, and Economic Development (ADCCED) Alaska Coastal Zone and Coastal District Boundaries map, the team identified communities in the coastal boroughs (Aleutians East and West, Lake and Peninsula, Bristol Bay, Northwest

[1] At the time of WEAR project planning, Bering Sea lease sales were proposed to occur in 2011, and were subsequently cancelled by the Obama administration

Arctic, North Slope) and unorganized areas along the coast in the Yukon and Kuskokwim River Deltas. River communities up to 300 miles upriver from the coast were also included in the project area due to the far-reaching impacts of coastal storms. The final project area included a total of 145 communities.

Initial Community Ranking

With a goal of evaluating potentially eroding sites in 95 - 100 communities, the next task was to analyze existing information regarding each community to determine a general ranking of the communities to help prioritize inspection planning. Some information regarding erosion is available for most of the communities in the US Army Corps of Engineers' (USACE) *Alaska Baseline Erosion Assessment* (BEA), but information on the relative environmental and health risks of specific sites within those communities is lacking. Therefore, any sites within each community identified as likely to be impacted by erosion required further assessment. In communities not addressed in the BEA, the rate and extent of erosion in the community would also need to be evaluated.

To locate contaminated sites within each community for the initial ranking process, the team utilized the CSP database as well as a 2011 Indian Health Service (IHS) spreadsheet of open dumps on Indian lands, an update for the *Report on the Status of Open Dumps on Indian Lands* (1998), which includes an inventory of landfills and dump sites throughout Alaska. In addition, imagery reviews were performed for 119 of the WEAR communities. Imagery reviews were not performed for communities already identified as high risk for erosion due to active erosion, or where no potential sites could be identified. Imagery sources included: BEA, Google Earth, Division of Community and Rural Affairs (DCRA), and ADEC Drinking Water Protection Area Map. The team reviewed community imagery to locate potential sites of environmental concern. For each site identified, the team recorded the distance to the shoreline and any previously measured, reported, or apparent erosion in the area near the site. For the sites of the most apparent concern within a community, a simple scoring matrix was applied to the data based on the likelihood of erosion within the next 50 years and the likelihood of the associated release of contaminants from those sites. From this effort 55 communities (Appendix D) were identified as priorities for inspections in the first and second field seasons of the WEAR project.

In addition to these priority communities, the team selected other communities for evaluation based on factors such as: proximity to priority communities, current population, available community information, existing mitigation efforts, and significant storm events. In all, the team visited 124 communities in the project area. Of the 55 high priority communities, only three (Diomede, Marshall, and Ugashik) were not visited due to flight cancellations or schedule conflicts.

Site Identification

For each of the communities selected for potential evaluation, the team began the work of analyzing information to identify any sites that might be a significant source of potential contaminants if they were to erode. The team used: SWP files, CSP database, IHS *Report on the Status of Open Dumps on Indian Lands* (1998), previously reviewed maps, DCRA Community information, and the BEA. Existing landfills, known contaminated sites, recognized dumpsites, military sites, mining sites, and other identified sites were plotted on community maps.

Inspection Parameters

The team identified the specific parameters that would be collected for each site for use in the relative risk analysis. With these parameters, a WEAR Site Information Form (Appendix E) was created by the team to aid inspectors in collecting site information and to standardize the data collected, improving the consistency of subsequent results. Site information collected on the form included: physical location (community, latitude, and longitude), type of site (landfill, tank farm, drum dump, military, and mining), expected contaminants, current erosion, erosion mitigation efforts, soil type, and distance to a drinking water source.

Figure 4. Use of Inspection Form by WEAR Inspector

Outreach

Once a community was selected for an inspection, the team worked to gather as much information as possible prior to travel to maximize the effectiveness of the time spent in the community. The team created a list of community contacts to ask for help in identifying potential sites to inspect while in the community. The team continued to develop contacts throughout the project and new contacts were added to the SWIMS database.

The team developed a Pre-Visit Site Survey (Appendix F) to record information gathered from interviewing community contacts. A team member was assigned to email information to each contact, including a brief explanation of the project, a map of sites identified in the community, and to arrange a call to request information on other potential sites that had not been identified. In the follow up call, contacts were requested to identify old landfills, tank farms, material or barrel dump sites, military sites, mining sites, or any other sites that might contain potential contamination. Information was recorded on the location, the type of site, the years of operation, materials that may have been dumped or spilled at the site, and the size of the site. Even when only a portion of the site details were collected, this was a crucial step in outreach to connect to the community network and to foster an understanding of the project.

In addition to our community contacts, the SWP created a webpage for the project, gave multiple presentations at the Alaska Forum on the Environment and the Alaska Tribal Conference on Environmental Management, and published flyers describing the project. Outreach information was updated and presented regularly to reflect progress on the project.

Training

Team members received training on the various desktop evaluation resources and tools used for the pre-inspection analysis, and also received training specific to the on-site inspection process. This included a review of the Site Information Form to ensure that consistent site data was collected by each inspection team, and basic photography and Global Positioning System (GPS) training to ensure the inspection teams took quality photos and documented site locations properly. Cross-cultural communications, appropriate field gear, and inspection planning were also addressed to facilitate successful inspections. Due to the unique safety and health hazards of traveling in rural Alaska, inspectors were trained to recognize potential physical (extreme weather), biological (pathogens, poisonous plants, and wildlife), and chemical hazards they might encounter in the field, and received first-aid, and small aircraft safety training.

Figure 5. Koyuk - Discussion of Landfill 2014

III. Database, Webpage, and Web Map

The SWP SWIMS database was modified to store the project's data and to create public access to the database. SWIMS can be accessed on the SWP page at http://dec.alaska.gov/eh/sw/. By storing the data in an actively maintained database, it can be updated after the project is complete. The SWP plans to update SWIMS as new information becomes available. However, the SWP does not plan to issue any further reports on the WEAR project beyond this final report.

At the start of the project, the SWP created a WEAR Project web page with the project description, location, and contact information for the public. Another web page was created after the first field season to host Preliminary Reports for the communities visited. Preliminary Reports (Appendix A) contain details of each site inspected within a community, including the site name, GPS location, status, a short description, and photos. The web pages were updated throughout the project to keep the public informed. The web pages will continue to be maintained beyond the end of the project to host this report and related documents.

The SWP has also maintained an ArcGIS[2] web map throughout the four-year project. The web map displayed all of the communities in the project, differentiating communities inspected and those not inspected. The map was updated with inspected sites at the end of each field season.

The final Alaska ADEC WEAR Map was created once all the field data was collected and analyzed. Figure 6 provides an example of the ADEC WEAR Map functions. The final ADEC WEAR Map is available to the public at http://dec.alaska.gov/eh/sw/wear.html and includes the following layers:

- **WEAR Community –** Community location with a pop-up that displays: population, year incorporated, and Alaska Native Claims Settlement Act status. This layer was provided by the ADCCED's Division of Community and Regional Affairs (DCRA).
- **WEAR Site –** Individual WEAR site location with a pop-up that displays: site name, type, status, latitude, longitude, manager, and a link to the site in the SWIMS database. This layer is linked to the SWIMS database and synchronizes nightly.
- **Drinking Water Protection Areas –** Delineated zones with a pop-up that displays: ADEC drinking water system ID number, system name, type, and activity status. This layer is provided by the ADEC Drinking Water Program.
- **Shoreline –** Layer displaying location of shorelines on map. This was produced from historical maps and GPS points collected in the field.

[2] Maps used throughout this report were created under license using ArcGIS Online® software by Esri and are the intellectual property of Esri. Copyright© Esri. All rights reserved. For more information about Esri® software, please visit www.esri.com.

- **Erosion –** Layer displaying location of active erosion. This was transcribed from BEA maps or delineated by reports from community residents.
- **Erosion Mitigation –** Layer displaying location of erosion mitigation. This information was produced from community visits and DCRA maps.
- **Boundaries –** Layer displaying boundaries of various sites, roads, fences, and other information of interest. These were hand drawn using information from community visits and other imagery.
- **Community Photos –**DCRA Community Profile Community Imagery, 1' or 6" resolution. This information is provided by DCRA.
- **Area Photos –** DCRA Community Profile Map Area Imagery, 2' pixel resolution. This information is provided by DCRA.
- **Bing Maps Aerial –** Base map imagery by Bing.

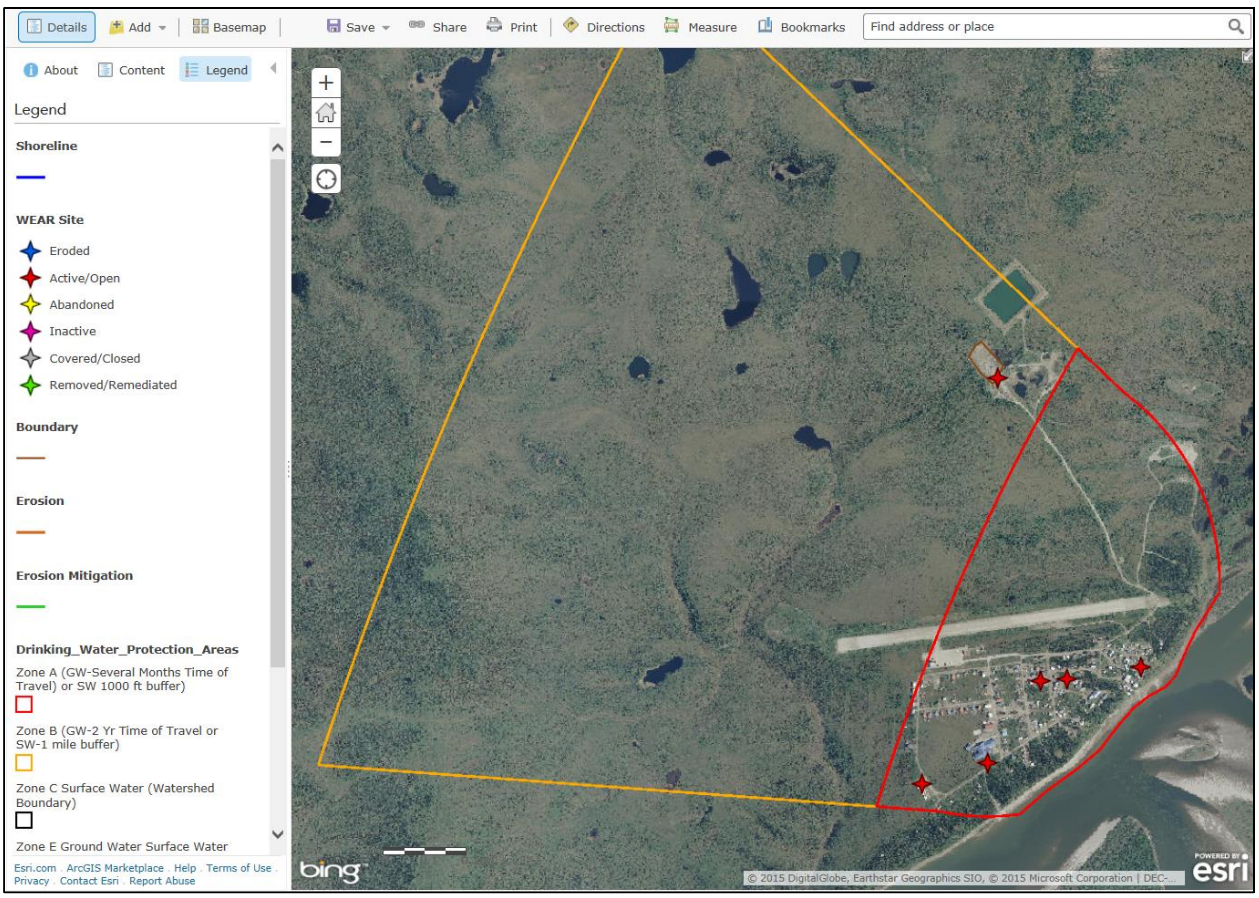

Figure 6. Kiana - Example WEAR Map (ADEC SWP, 2015)

IV. Field Inspections

Field inspections took place from May through September in 2012 to 2014. Due to the remote location of sites, field visits were completed during the summer season when travel is most feasible and there is less snow cover. Considerable planning for field visits required coordinating with community members, other inspectors, and flight schedules. Most communities were accessed via small aircraft. A truck, all-terrain vehicle, or boat was used to travel to each WEAR site within the community. Some sites were only accessible by foot. Even with the most detailed planning, inclement weather or aircraft mechanical problems required flexibility in the field, and occasionally kept inspectors from accessing a community.

Figure 7. Boat Access by WEAR Inspector

In the field, inspectors worked in groups of two or three to facilitate data collection. Each trip was typically four to five days long and included three to six communities. Inspecting multiple communities in each trip significantly reduced travel time and maximized travel funds. Typically, inspectors spent a day in each community, sometimes overnighting in the community, or traveling each day from a hub community.

Prior to travel, conducting the pre-inspection research allowed inspectors to become familiar with the community and the location of known WEAR sites, and to more efficiently plan their time. The inspector's plans to meet with community members included representatives of the City and Tribal Council, Indian General Assistance Program (IGAP) Environmental Coordinators, environmental coordinators and interested individuals. Individuals within the community were often the best source of information regarding site locations, histories, and past erosion.

For each WEAR site, inspectors completed the Site Information Form (Appendix E) to collect site data. Site photos were also taken to further document physical conditions. The information was used to create Preliminary Reports (Appendix A) for each community. In addition to site inspections and meeting with community members, the SWP also conducted a routine landfill inspection in each community using the SWP Waste Index, which was developed as a tool to help identify deficiencies in rural solid waste management and provide incremental goals for improvement. Routine inspection results can be viewed at any ADEC SWP office.

For each WEAR site, inspectors recorded location in decimal degrees using GPS units. The size of the site was calculated, in acres, by either using a measuring tool in ArcGIS Online or taking multiple GPS points around the perimeter and plotting the data. Inspectors documented other areas of interest such as active erosion, drinking water sources, subsistence use areas, critical habitat, or residences, and determined the distance in feet to each WEAR site. Erosion characteristics were recorded, such as the types of erosion, contributing factors, and symptoms. Soil type for each site was recorded according to the USCS, as it is a significant factor in erosion. For example, soils with a large silt content are more prone to erosion than gravel, due to particle size, structure and cohesion.

Figure 8. Documenting Erosion by WEAR Inspector

Inspectors also recorded GPS points along shorelines and plotted them on historical imagery to document any change over time and to estimate an erosion rate. Photos were taken of erosion and any mitigation measures to document the current conditions. Several sites were inspected a second time during a follow-up visit, and photos provided visual documentation of changes in site conditions and erosion.

The number of WEAR sites inspected in each community ranged from 1 to 21 sites, with an average of about 6 sites. A total of 124 communities and 716 WEAR sites were inspected for the project. Twenty-four of these communities were re-inspected during a follow-up visit for additional data collection. Active erosion was noted in 105 of the communities. The list of communities visited during the WEAR project is provided below in Table 1.

Table 1: WEAR Communities Visited

Adak	Ekwok	Lower Kalskag	Red Devil
Akiachak	Elim	Manokotak	Russian Mission
Akiak	Emmonak	Mekoryuk	Saint George
Akutan	False Pass	Mountain Village	Saint Mary's
Alakanuk	Gambell	Naknek	Saint Michael
Aleknagik	Golovin	Napakiak	Saint Paul
Ambler	Goodnews Bay	Napaskiak	Sand Point
Aniak	Grayling	Nelson Lagoon	Savoonga
Anvik	Holy Cross	New Stuyahok	Scammon Bay
Atka	Hooper Bay	Newhalen	Selawik
Atmautluak	Igiugig	Newtok	Shageluk
Atqasuk	Iliamna	Nightmute	Shaktoolik
Barrow	Ivanof Bay	Noatak	Shishmaref
Bethel	Kaktovik	Nome	Shungnak
Brevig Mission	Kasigluk	Nondalton	Sleetmute
Buckland	Kiana	Noorvik	Solomon
Chefornak	King Cove	Nuiqsut	South Naknek
Chevak	King Salmon	Nunam Iqua	Stebbins
Chignik	Kipnuk	Nunapitchuk	Stony River
Chignik Lagoon	Kivalina	Oscarville	Teller
Chignik Lake	Kobuk	Pedro Bay	Togiak
Chuathbaluk	Kokhanok	Perryville	Toksook Bay
Clark's Point	Koliganek	Pilot Point	Tuluksak
Cold Bay	Kongiganak	Pilot Station	Tuntutuliak
Council	Kotlik	Pitka's Point	Twin Hills
Crooked Creek	Kotzebue	Platinum	Unalakleet
Deering	Koyuk	Point Hope	Unalaska
Dillingham	Kwethluk	Point Lay	Upper Kalskag
Eek	Kwigillingok	Port Alsworth	Wainwright
Egegik	Levelock	Port Heiden	Wales
Ekuk	Lime Village	Quinhagak	White Mountain

V. Risk Calculation

ADEC and other agencies have previously taken separate efforts to assess either contaminant risk or erosion risk. However, the WEAR project assesses risk from impacts of both. The WEAR project evaluated not only the physical erosion risk but also the potential human health and environmental risks posed by the release of contaminants into the environment from erosion of sites.

The WEAR project identified possible site contaminants and exposure pathways. Environmental contaminants can be hazardous to human health and the environment. The health risk depends on the specific contaminant and the exposure pathway (how someone might come into contact with a contaminant, how long they will be exposed to it, and how they will take it into their bodies).

Erosion risk can be determined by evaluating various physical characteristics of a site and by estimating the erosion rate. The WEAR project identified specific site characteristics, including, erosion symptoms and soil type, that may make a site more vulnerable to erosion, and estimated how long it might be before the site is impacted. This information was then translated into erosion risk.

The Risk Calculator was developed to evaluate the data collected. The Site Information Form (Appendix E), used during inspections, standardized the information gathered for each WEAR site. This allowed for site risks to be calculated and sites to be compared using the same criteria. Sections from the form are assigned a weighting factor of 1 to 3 corresponding to relative importance, then each parameter within a section received a multiplier corresponding to relative risk. Parameters are scored based upon their corresponding risk level. The weighting factors and multipliers used in the Risk Calculator are presented in Appendix H.

Contaminant Risk

The potential contaminant health risk depends on how toxic the contaminant is and the potential for someone to be exposed to it. Specific parameters considered for determining contaminant risk include: possible site contaminants, status of the site, size of the site, years of operation, whether the site is within a drinking water protection zone, and the proximity to residences, critical habitat, and stressed habitat.

Type of Contaminant

The types of contaminants potentially present at a site are an important consideration in determining contaminant risks, as some contaminants, such as PCBs, heavy metals, and dioxins, are more toxic than others and pose a greater health risk. The WEAR project did not include collection of environmental samples for analysis to determine site contaminants. Instead, contaminants for each site were assumed based on knowledge of contaminants associated with a site type using professional judgement. Possible site contaminants were also assessed during site inspections through field observations such as the presence of drums or tanks labeled with contents, transformers labeled as PCB-containing, or presence of lead-acid batteries. The majority of contaminant sources of WEAR sites fell into one of three basic categories: landfills, tank farms, and other contaminated sites. These basic categories are further broken down into specific sources of contaminants.

- **Landfills**
    - Municipal Waste
    - Sewage
    - Burning of solid waste
    - Construction and Demolition Debris/Asbestos
- **Tank Farms**
    - Fuels
- **Contaminated Sites**
    - Industrial Waste (fish processing, tanneries, oil and gas, etc.)
    - Military Waste
    - Mining Waste

Landfills

Each community has a solid waste disposal site (landfill) where everyday household waste, known as municipal solid waste (MSW), is disposed. Although the rural communities produce smaller quantities of waste than larger urban communities, if the landfill is inadequately designed or operated they may pose a significant risk to human health and the environment. MSW may include household hazardous wastes (HHW) such as cleaners, automotive maintenance products, batteries, and paints. Poor operations include waste not being segregated, improper burning, waste placed in or near water, waste not covered with soil, no site control to restrict public access, and other factors. Poor landfill operations can have immediate and long-term impacts to the environment and human health by releasing multiple contaminants that may have cumulative (additive) or even synergistic (more than additive) effects.

Disposal of human waste (sewage) at the landfill is also a concern in communities that lack plumbed sewage systems, or dispose of sewage solids or septage from the community system in the landfill. Communities without sewage systems use “honeybuckets” for human waste. This is typically a five-gallon bucket lined with a trash bag. Sewage is a greater concern if it is co-disposed with municipal waste rather than managed properly by disposal and decontamination in a separate area or trench.

Many rural landfills burn waste to reduce the volume, but improper or incomplete burning of waste can pollute the air, soil, and water with contaminants such as dioxins, gases, heavy metals, and polycyclic aromatic hydrocarbons (PAHs). Dioxins are formed when plastics are burned and are persistent in the environment. Gases such as carbon monoxide, sulfur dioxide, and nitrogen oxides that impact air quality, may be released when waste is burned. Heavy metals such as mercury and lead are released when batteries and electronics are burned. PAHs are formed from the incomplete combustion of fuels and waste and are commonly found in smoke and soot. Many of these contaminants are persistent in the environment, can bioaccumulate, and have known toxic effects. Not only can they cause chronic diseases such as cancer, heart, kidney, liver, and lung diseases, but can also have acute (immediate) effects such as burning of eyes, coughing, and breathing difficulties. Improper and incomplete burning of waste not only poses an immediate human health risk within the site area, but erosion of these contaminants can cause further reaching impacts.

Figure 9. Toksook Bay - Landfill C&D Waste and Drums 2014

Construction and demolition debris (C&D) is typically disposed in or near the community landfill. C&D is a concern due to the possible presence of asbestos. Asbestos was widely used in construction materials prior to the 1980s and remains in many rural communities in their older structures. Asbestos is known to cause lung cancer, but does not pose a health risk if it remains contained and is not released to the environment. Asbestos released to water due to erosion is less of a health concern; however, asbestos fibers released to the air pose a more significant risk to human health and the environment. Once asbestos fibers are released they are difficult to clean up, which can result in both short term and long term impacts. Maintaining containment of asbestos in a landfill by preventing erosion is essential to protecting human health and the environment.

Landfills have a complex set of factors to consider in evaluating contaminant risk. The Risk Calculator addresses the disposal of household waste, C&D, and sewage, as well as burning of waste to identify contaminant risk.

Tank Farms

WEAR project communities are not connected to a major road system and rely on infrequent (once or twice a year) fuel deliveries. Tank farms store the volume of fuel needed until the next delivery. Fuel storage tanks range in capacity from 5,000 to over 1,000,000 gallons per tank, and store primarily gasoline or diesel fuel. Leaks or spills from these tanks may contaminate nearby soil and water. Contaminants associated with fuels include benzene, PAHs, and possibly lead from leaded gasoline. These contaminants are known to cause cancer and other chronic diseases. The type of fuel, tank volume, and years of operation are important factors in assessing the potential health risk for these sites.

Contaminated Sites

Contaminated sites include industrial, military, and mining sites. These industrial waste sites are assumed to contain operational wastes including hazardous waste, mixed waste, and fuels. Due to the nature of the waste and the potential quantities, these types of sites are presumed to pose greater risk to human health and the environment. Many coastal communities participate in the commercial fishing industry. Fish processing, tanneries, oil and gas, and other industries in Alaska commonly use chemicals and produce large quantities of industrial waste. Various disinfectants, cleaning agents, refrigerants, acids, and other industrial chemicals are commonly used in fish processing. Contaminants associated with tanneries may include heavy metals, acids, biocides, and solvents. The oil and gas industry has operated and still operates near some of the communities, and historically produced and buried contaminated waste. The mining industry produces large quantities of waste rock and tailings that is of concern due to the potential for acid generation which leaches metals and the industrial materials used in processing ore and maintaining facilities. The range of possible contaminants related to each industry, and often the lack of information available on some historic sites create uncertainty in the assessing contaminant risk. The Risk Calculator assumed a relatively higher level of risk when addressing these sites.

Other Site Risk Assumptions

WEAR sites are scored based upon site status (abandoned, active/open, covered/closed, inactive, or removed/remediated), size, and the years in which the site was operational. Active/Open sites were scored highest for their potential to continue to accumulate waste. Inactive or abandoned sites were scored next highest in that although waste or contamination remains, there is no continued accumulation to further contribute to contaminant risk. Closed/covered sites present even less contaminant risk given the reduced potential for exposure and migration of contaminants. Sites are characterized as small, medium, or large based upon approximate acreage (0 - 1, 1 - 5, or > 5 acres, respectively) with the larger sites scoring highest due to the potential for more volume to contribute to contaminant risk. The timeframe of site operation is also assessed as an indicator of possible contaminants that might be present. Sites in use prior to the 1960s predate most all major environmental laws regulating proper management, handling, and disposal of materials and wastes now known to pose risks to human and environmental health. Although during the 1960s to 1980s several major environmental laws were enacted, there were still few that regulated some widely-used hazardous materials. It was not until the 1980s that modern environmental laws were enacted to more effectively regulate hazardous materials and wastes. Sites that predate major environmental laws are more likely to have been operated without regard for possible human and environmental impacts and so are considered to have a higher potential for contamination.

Drinking Water Protection Zones

Drinking contaminated water is a primary means by which people may be exposed to harmful contaminants that can impact their health. WEAR sites were assessed by whether they were located in a drinking water protection zone that could be potentially contaminated. Sites closest to a drinking water source scored highest for contaminant risk in this regard. Drinking water sources were identified by documented community drinking water sources and by mapped drinking water protection zones. The ADEC Drinking Water Program has defined drinking water protection zones based on the shortest amount of time it takes for a contaminant to travel to the drinking water source. These zones range from an area that can impact the drinking water in a few weeks, months, or years. Each zone is defined in the Risk Calculator and an example of the mapping shown on Figure 6. Erosion of contaminated sites may significantly reduce the contaminant time of travel for impacting downstream surface water sources of drinking water.

Location Proximity

The potential for contaminant exposure and possible health and environmental impacts depend, in part, on the probability of coming into contact with a contaminant. With a higher chance of accessing a site, by touching, ingesting, or inhaling the contaminant, the potential health and environmental impacts increase. Three measurements were taken specifically to assess the contaminant proximity risk for a site. These measurements include the distance to the nearest residence, to the nearest stressed habitat, and to the nearest critical habitat. Each of these is discussed separately in the following paragraphs.

Residences

The closer a WEAR site is to a residence, the higher the potential for human exposure to site contaminants. Many WEAR sites are within communities and in close proximity to residences, so the likelihood of contaminant exposure is high. The distance to the nearest residence was measured using community maps and aerial imagery from DCRA and then confirmed by field observations.

Stressed Habitat

Signs of stressed habitat include areas devoid of typical plant life or the presence of dying vegetation. The presence of stressed habitat is a direct indicator of an environmental impact caused by contaminants. Sites were scored based on the presence of stressed habitat. The most commonly observed examples of stressed habitat noted during the inspections included the presence of petroleum-stained soil and dead vegetation associated with WEAR sites.

Critical Habitat

Critical habitat is a specific geographic area essential for the conservation of a threatened or endangered species (USFWS, 2015). These areas not only support the most sensitive species, but also important subsistence species that many rural communities rely upon for their livelihood. The proximity of WEAR sites to critical habitat is a consideration for contaminant exposure because environmental contaminants not only can harm the plants and animals exposed to them, but they may also bioaccumulate or bioconcentrate in plants and animals posing a risk to humans that consume them. USFWS has mapped critical habitats across the United States and made this information available to the public with their online Critical Habitat Mapper, which was used to identify locations of specific critical habitats associated with each WEAR site inspected. Using aerial imagery, the distance to critical habitat was measured and sites were scored according to their proximity to critical habitat. Many WEAR sites were either within or in close proximity to critical habitats, as illustrated in Figure 10 and 11.

Figure 10. WEAR Community Map (ADEC SWP, 2015)

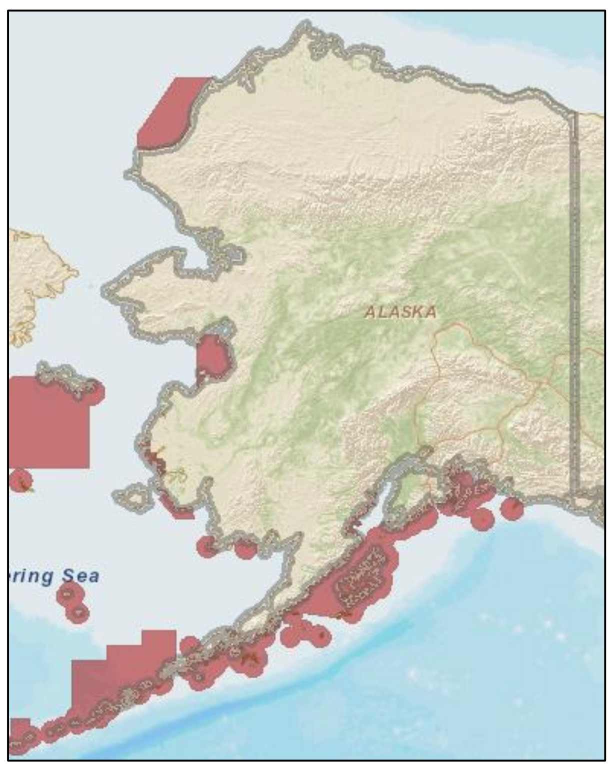

Figure 11. Critical Habitat Map (USFWS, 2015)

Erosion Risk

Alaska has over 6,640 miles of general coastline[3] (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 1975), which is more than half of all the coastline of the United States, and contains some of the largest rivers in North America. Another unique characteristic of Alaska is the presence of permafrost. As climate and seasons change, frozen ground can thaw making it more susceptible to erosion. During the spring, frozen rivers begin to break up and can create ice jams. Ice not only scrapes and gouges away riverbanks, but can act as a dam, resulting in flooding and erosion of land adjacent to the river. Tides constantly impact coastlines and storms often accelerate erosion rates. Human activities may have also accelerated erosion in Alaska. Development over the years, including the removal of protective vegetation, the building of infrastructure, and increased boating traffic, has disturbed shorelines and made them more prone to erosion.

A number of physical parameters were evaluated to determine erosion risk. Erosion rates were either calculated by other agencies, reported by community residents, or estimated from distances either measured in the field and compared with community imagery or measured in two dated aerial/satellite images. The number of years until erosion impacts a WEAR site was estimated by using the erosion rate and distance from the area of active erosion. The result was used to assign erosional risk within a range from erosion is actively occurring or is imminent (will occur within 5 years) to erosion is unlikely in the foreseeable future (will not occur for more than 50 years). Note that these rates and timeframes are estimates and may not adequately take into consideration extreme storm events or spring breakups causing significant erosion. Erosion type, factors, and symptoms were also assessed for their contribution to erosion risk as discussed in *Understanding and Evaluating Erosion Problems* published by DCRA in 2013. Soil type was also considered as some soils are less likely to erode than others. The calculated erosion risk based on these factors does not reflect an absolute score, but is designed to compare the sites against one another.

River Erosion

Traditionally, communities have been located near rivers to utilize them as a source of drinking water and food, as well as a transportation corridor. River erosion is a primary concern for many of Alaska's communities and displays many symptoms, including slides, undercutting, exposed permafrost, scarps, root exposure, fallen trees, and ice gouging. Residents of several communities reported ice gouging as a cause of erosion during spring break up. Many fallen trees and exposed roots were seen during the WEAR inspections. Riverbank erosion was noted during the WEAR inspections, as shown in Figures 14-22 (photos).

[3] General coastline refers to the general outline of the seacoast. This was measured from nautical charts in 1948.

Kuskokwim River

Communities as far as 300 miles up the Kuskokwim River (Figure 12) and its tributaries were inspected as part of the WEAR project. The Kuskokwim River has strong currents, discontinuous permafrost, flooding, and human-influenced erosion. The Kuskokwim River is essential to many communities in western Alaska. The communities inspected along this river and its tributaries ranged from Tuntutuliak, near Kuskokwim Bay, to Lime Village.

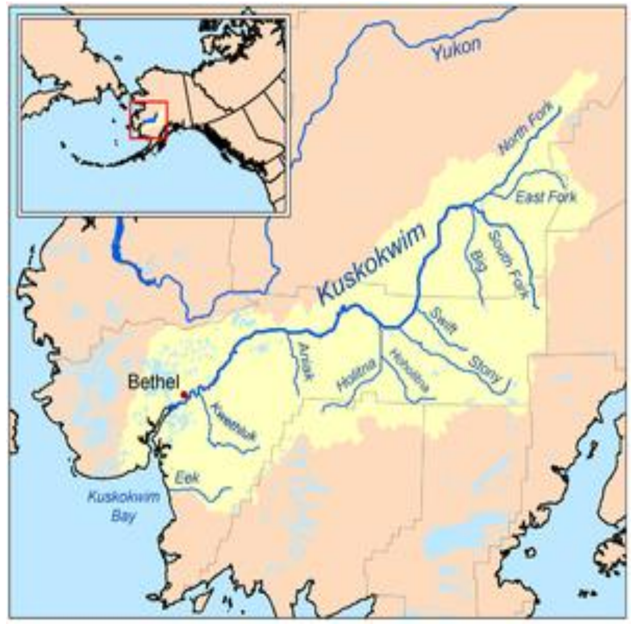

Figure 12. Kuskokwim River (Wikimedia upload, 2015)

Yukon River

The Yukon River is the largest river in Alaska. It is over 1,900 miles long with 1,200 of those miles in Alaska. Historically, the Yukon River was used for transportation during the Klondike gold rush, today it is known for the large Chinook salmon population. Many communities rely on the fish from the river for subsistence. The WEAR project inspected communities from Nunam Iqua on the Bering Sea coast to Grayling, approximately 300 miles upriver.

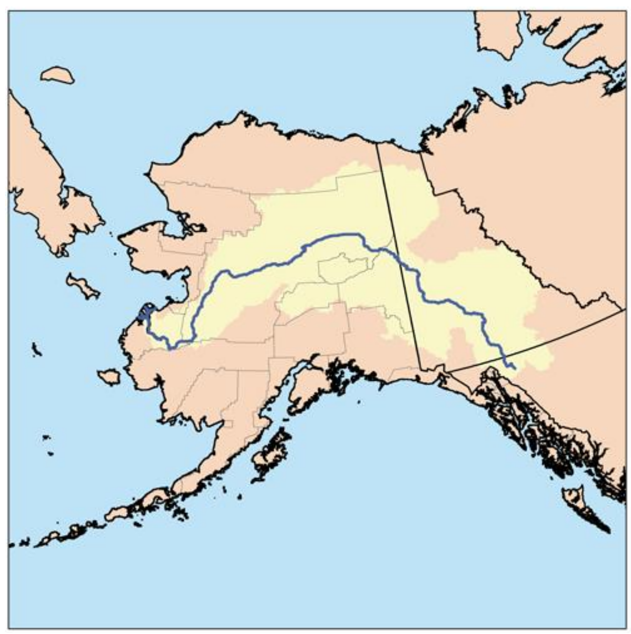

Figure 13. Yukon River (Wikimedia upload, 2015)

Kuskokwim River Pictures

Figure 14. Tuntutuliak - Riverbank Erosion 2012

Figure 15. Aniak - Riverbank Erosion 2013

Figure 16. Akiachak - Riverbank Erosion 2013

Figure 17. Akiak - Riverbank Erosion 2012

Figure 18. Lower Kalskag - Riverbank Erosion 2012

Yukon River Pictures

Figure 19. Nunam Iqua - Riverbank Erosion 2014

Figure 20. Alakanuk - Riverbank Erosion 2014

Figure 21. Mountain Village - Riverbank Erosion 2012

Figure 22. Emmonak - Riverbank Erosion 2014

Coastal Erosion

Coastal communities in Alaska experience erosion from tides and large storms. Historically, sea ice has protected coastlines from storm surges during fall and winter storms. More recently, sea ice has not consistently formed, leaving little or no barrier against fall and winter storm surges that can cause large erosion events. Like river erosion, coastal erosion can exhibit many symptoms including slides, undercutting, exposed permafrost, scarps, root exposure, and ice gouging.

Most WEAR coastal communities are not connected by road and are only accessible by plane or boat. Coastal erosion can also impact these transportation methods by damaging runways and barge landings. In cases of extreme erosion, some communities have retreated inland, or relocated entirely. Figures 23-25 demonstrate examples of coastal erosion documented during the WEAR inspections.

Figure 23. Wainwright - Shoreline Erosion and Riprap Installation 2013

Figure 24. Shishmaref - Shoreline Erosion 2012

Figure 25. Kivalina - Shoreline Erosion 2014

Soil Types

Soil type significantly impacts the potential for a site to erode. Some soil types are more prone to erosion than others. For instance, cobbles and gravels are not easily moved due to particle size. Clay has very small particles, but greater cohesive properties (sheer strength) than sands, making clay soils less susceptible to erosion than sands. While sands, organic soils, and loams erode readily, silts have the greatest potential for erosion (ADCCED DCRA, 2013). In the field, inspectors recorded soil types, based on the Unified Soil Classification System (USCS), in estimated percentages. WEAR sites were scored based upon the relative potential of the recorded soil types to erode.

Erosion Mitigation

Many communities have attempted to control erosion to mitigate its potential effects. WEAR sites were scored on whether any erosion mitigation measures were installed at the site. For the purposes of erosion risk calculation, the effectiveness of the mitigation measures was not considered. Regardless of whether mitigation efforts were successful, they represent the community's acknowledgment of the issue and the need to take action.

Evaluating Contaminant and Erosion Risk

Contaminant and erosion risk cannot simply be summed nor can they be considered entirely independently. For instance, some sites (such as fuel tanks) were actively eroding, which resulted in high erosion risk, but scored relatively low for contaminant risk due to the contaminants. Alternately, there were sites that scored high for contaminant risk but were not likely to erode in the foreseeable future. Both the erosion risk and the contaminant risk were considered for identifying those sites with the highest overall risk. Overall risk was evaluated by considering the statistical distribution of the contaminant risk and erosion risk scores.

VI. Final Site Rankings

Over the course of the WEAR project, data was collected on 716 sites. Five of these sites had either already eroded or did erode during the project, and were excluded from scoring, leaving 711 sites for scoring. Erosion and contaminant risk scores are plotted against each other as presented in Appendix G. Those sites not likely to erode in the next 50 years were excluded from priority ranking. This criteria eliminated 605 sites, leaving 106 sites for final ranking. Of these, the 20 sites that fall within the top 25% for both the erosion risk and contaminant risk score (Table 2) were identified as high risk sites and a DAP was developed (Appendix B). Each DAP summarizes the information collected during the inspection, contaminant risk and erosion risk, mitigation options for the site, and makes recommendations based on those options for protecting human health and the environment. The DAPs for these sites are provided in Appendix B.

No DAPs were developed for sites that did not meet the criteria described above. Several sites demonstrated high erosion risk, but did not receive DAPs because high scores for both erosion risk and contaminant risk were required. Even if a site was actively eroding, without a high contaminant score, a DAP was not developed.

Table 2: WEAR Project High Risk Sites

Alakanuk Old BIA School
Alakanuk South Side Dump Site
Chevak Company Corporation Tank Farm
Chevak Former AVEC Tank Farm
Chevak Former City Tank Farm
Chevak Old River Landfill
Dillingham IHS Hospital Site
Emmonak Landfill
Golovin Fish Processing Plant
Kalskag Consolidated Tank Farm
Kotlik Landfill
Kotlik LYSD Former Tank Farm
Napakiak Corporation Tank Farm
Napakiak School Tank Farm
Nelson Lagoon Landfill
Newtok Backhaul Staging Area
Newtok UPC Generator Building
Nunapitchuk Old Elementary School Tank Farm
Oscarville School Tank Farm
Shageluk City Tank Farm

VII. Erosion Mitigation Methods and Costs

Erosion mitigation methods are varied in design and in success. Mitigation methods are designed to protect land or infrastructure in place by three basic strategies: 1) Diminishing the energy source, by installing a breakwater or dike to reduce current or wave impacts, or insulation to protect permafrost; 2) Shielding the site with a barrier, such as a stone or concrete revetment, seawall, or increased vegetative cover; or, 3) Create new beach by creating deposition using groins or breakwaters constructed perpendicular to the shoreline (ADCCED DCRA, 2013). In addition, reducing human activity that promotes erosion is important to protecting shorelines.

Figure 26. Naknek - Seawall 2013

Figure 27. Quinhagak - Seawall 2013

Based on observations made during WEAR site inspections, one of the most common methods for protecting infrastructure from severe erosion was use of a barrier. Several communities have constructed corrugated metal or wood barriers (Figures 26, 27, & 28).

Figure 28. Teller - Seawall 2013

Revetments were also a common mitigation method in WEAR communities (Figures 29-32). Revetments varied in sophistication from rocks (known as riprap) on the shoreline or as complicated as engineered tiled concrete. Revetment construction may be more cost effective when local materials are used.

Figure 29. Chignik Lagoon - Revetment 2012

Figure 30. Kivalina - Revetment 2014

Figure 31. Kongiganak - Revetment 2013

Figure 32. Nelson Lagoon - Geotube Erosion Mitigation 2013

Some erosion mitigation methods are more effective than others based upon the type of soil and erosion occurring. Table 3 presents examples of the erosion mitigation efforts some communities have employed and their relative effectiveness based on local observations.

Table 3: Community Erosion Mitigation Measures

Community	Affected Area	Erosion Mitigation	Effectiveness[4]
Coastal Communities			
Adak	Southeast of community; near Metals Landfill	Rock revetment	Installed in 1996; intact[5]
Atka	Southern most end of the community	Riprap	Installed in 1980s; intact
Clark's Point	North of the community; protecting canneries	Concrete blocks	Installed 1980s; damaged (WEAR 2012)
Dillingham	Southeast end of community; near boat harbor	Sheet pile bulk head	Installed 1983-99; intact
Egegik	West of community; near fish plants	Log structures	Ineffective (Community residents reported)
False Pass	Coastline near City dock; Unimak Drive	Concrete blocks and gravel	prevents erosion (Community residents reported)
Hooper Bay	Northwest of community; near runway	Concrete blocks	Concrete blocks failed 2004 (BEA)
		Sheet pile retaining wall	Installed prior to 2000; intact
Kivalina	Entire city is at risk	Rock revetment	Installed in 2006; intact
Mekoryuk	City harbor; west side of community	Rubble mound breakwater	Installed in 1986; intact
Nelson Lagoon	Shore south of the community	Geotube revetment[6]	Installed 2005; intact
Nome	Entire community shoreline	Seawall and riprap	Installed 1993; intact
Pilot Point	Shore west of the community	Large rocks	Erosion reduced (BEA)
Quinhagak	City dock; west of the community	Sheet pile retaining wall	Installed prior to 2003; intact
Shishmaref	Shore north of the community	Rock revetment	Installed 2013
Stebbins	City shoreline; west of community	Oil drums filled with sand	Installed 1960's; eroded prior to 2008 (BEA)
Teller	Port Clarence; west of the community	Seawall	Installed prior to 2007; intact
Togiak	Shoreline south of the community	Seawall and bulkhead	Installed 1987; intact (requires repair BEA)
Wainwright	Shore north of the community	Rock revetment	Installed 2013

[4] (BEA) references the *Alaska Baseline Erosion Assessment* reports current as of their published dates 2005-2009
[5] Intact refers to visual observations from the most recent WEAR inspection. WEAR reports are current as of their inspection date ranging 2012-2014
[6] A Geotube, in this case, is a layer of Geotechnical Fabric wrapped and overlapped around local soils to provide a more stable barrier to erosion.

Community	Affected Area	Erosion Mitigation	Effectiveness
River Communities			
Ambler	Riverbank northeast of community	Concrete bags	Lasted from '88-08, now eroding (BEA)
Aniak	East end of the community	Concrete mat revetment	BEA reported erosion at 0.5ft/year
Bethel	Petroleum dock to Bethel City dock	8000 foot Seawall with rocks	Installed 1997; intact
Chefornak	Entire community shoreline	Fabric mats and a jetty	Jetty is effective; mats failed in 2007 (BEA)
Chevak	Southeast of the community; Ninglikfak River	Sandbag Revetment	Still eroding at 5 ft/yr (Community residents reported)
Chignik Lagoon	Packer’s Creek	Rock revetment	Installed in 2011; intact
Deering	Inmachuk River	Riprap	2-3% loss per year (BEA)
Kipnuk	North end of the community; Kuguklik River	Geotextile fabric and local materials	Ineffective (Observed; WEAR inspections)
Kongiganak	Riverbank north of community	Rock revetment	Installed in 2008; intact
Naknek	Naknek riverbank	Metal retaining wall	Installed prior to 2004; intact
Noatak	Shore east of the community	Concrete mat	Installed 1982; damaged but effective (BEA)
		Wood retaining wall	Installed in 1990s; failed following year (BEA)
Tuntutuliak	South and east of the community; Kinak River	Rock revetment	Installed in 1990s; expected life 2020-30 (BEA)

Erosion Mitigation Costs

There are many erosion mitigation methods to consider, all with significant associated costs. Each must be considered based on site-specific conditions. Estimating costs can be difficult given the many factors involved such as location, labor, and availability of equipment and materials. Considering a comparable project in a similar location may provide an approximation of total project costs. Some examples of recent erosion mitigation projects with their associated costs and a list of potential funding sources can be found in Appendix C.

VIII. Additional Project Benefits

At the onset of this project, ADEC recognized that beyond the stated goals the project had potential to provide additional benefits to both communities and the SWP. Specific additional benefits included:

- Community Outreach
- Environmental Community Assistance
- Implementation of Revised Class III Landfill Requirements
- SWIMS Incorporation of WEAR Project Data

Community Outreach

The WEAR Project provided the SWP the opportunity to travel to many rural villages not frequently visited by outside entities. Normally, the SWP travels to villages with the sole purpose of performing landfill compliance inspections, which can be deemed imposing by community members, despite SWP efforts to focus on compliance-assistance rather than on regulatory enforcement. Although the SWP still conducted landfill inspections, the nature of the WEAR project visits was more focused on gathering and sharing information beyond landfills. This promoted more communication between the SWP and members of the community. It also provided the opportunity to establish contacts with community members that could help improve solid waste management.

Environmental Community Assistance

The WEAR project goals included evaluating 95 to 100 communities. Inspectors exceeded this goal by using creative planning that allowed them to reach 124 communities. While the project budget assumed one community visit per trip, the inspectors visited an average of 3 to 4 communities in each trip. Inspectors maximized travel funds by either traveling each day from a hub community or traveling daily from one community to another.

Traveling to these 124 communities provided the opportunity to not just assess more WEAR sites in more communities, but also to identify additional environmental issues. The SWP forwarded a number of these issues to other ADEC programs as appropriate for follow-up.

- Information on previously undocumented contaminated sites, contaminated soil stockpiles, and tank farms was forwarded to the ADEC Prevention and Emergency Response Program (PERP) for follow-up as needed.
- Information on bed bug infestations was forwarded to the ADEC Pesticide Control Program for technical assistance.
- Improper disposal of C&D waste by licensed contractors was discovered at unpermitted landfill and the SWP took enforcement action against the contractor and developed outreach material to address legal disposal of C&D waste.
- The SWP inspected community landfills that had not recently or ever been inspected. The information collected will provide the SWP a good basis for assisting the community with improving their solid waste management.

Implementation of Revised Class III Landfill Requirements

During the same time frame as the WEAR project, the SWP implemented significant improvements to the Class III landfill requirements. While the Project Narrative did include a commitment to assess each active community landfill, the WEAR project gave the SWP the opportunity to do far more work with communities to address solid waste management goals than was envisioned at the time when the Project Narrative was created. Improvements in permitting and compliance are a direct result of the WEAR project.

Class III Landfill Implementation Activities

The SWP has been actively working on revising its approach toward managing Class III landfills since the time that work began on the WEAR project in 2011. Class III landfills are very small (less than 5 tons of waste disposed per day), are a category of landfills specific to remote Alaska communities, and are the classification of landfills in the majority of the WEAR communities. Many communities with Class III landfills have faced challenges in complying with regulatory standards as the permitting process is complex and requires an understanding of the regulations and information required.

The new strategy that the SWP developed includes a more streamlined permitting process and development of a landfill inspection/compliance tool called the Waste Index. The Waste Index was implemented in 2012 and regulation changes that included revised permitting procedures were enacted in early 2013. These changes provided clearer guidance on permitting and a more effective means of communicating incremental steps to improve landfill operations. Additionally, the SWP put more staff focus on Class III landfills, with a deliberate focus on outreach and one-on-one work with community decision makers. The WEAR Project provided an excellent and timely opportunity to implement this new strategy in a large number of communities.

Class III Landfill Performance Improvements Achieved

A key goal of the SWP is to improve operations at landfills in Alaska. Two factors that the SWP uses to measure overall landfill performance for the Class III landfills include the percentage of Class III landfills permitted and landfill inspection scores (reported as a percentage using the Waste Index score sheet).

The SWP was able to work with communities and collect detailed information for the landfills to show improvement on both of these performance measures over the course of the WEAR project.

- The SWP issued 37 new Class III landfill permits to WEAR communities that were inspected over the course of the four-year project.

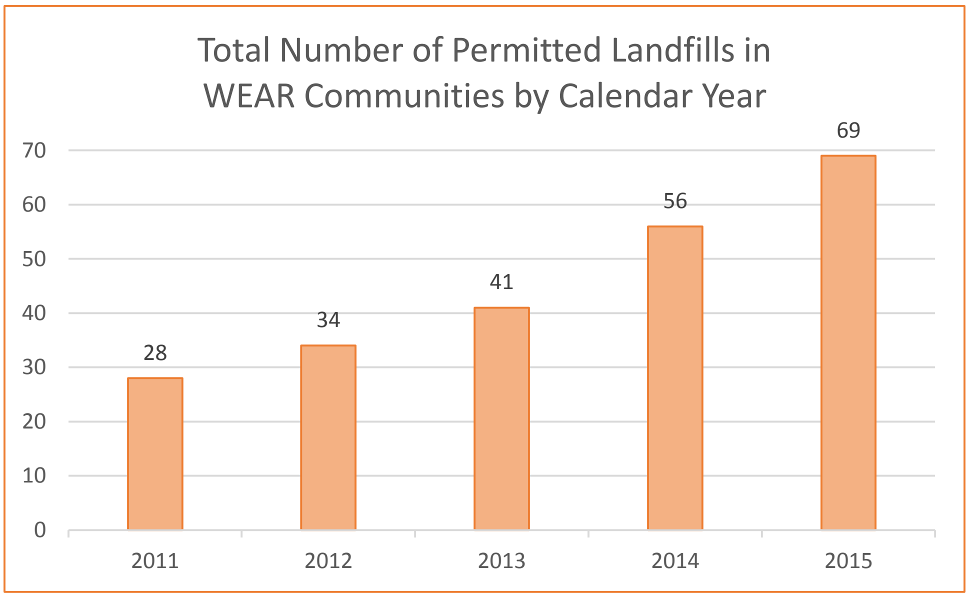

Figure 33. Total Number of Permitted Landfills in WEAR Communities by Calendar Year

- The SWP implemented the Waste Index during the WEAR project at 111 Class III landfills. The SWP would have only been able to implement this tool at a fraction of these landfills without the community access provided by the WEAR project. These initial WI scores provide a valuable baseline for landfill operations which can be used to evaluate improvements in the future. Improvements have already been noted for several WEAR landfills re-inspected over the course of the project.

Incorporation of WEAR Project Data into SWIMS

Changes made to the SWIMS database during the WEAR Project provided for better overall functionality of the database. The changes included a variety of improvements such as:

- Ability to update information on WEAR sites in the future. Storing WEAR data in an actively maintained database will ensure future information can be input and sites can be updated. This will also allow for any future erosion studies to easily access this information.
- Addition of SWIMS public interface. This allows the public to easily obtain data on both WEAR sites and other solid waste sites. The previous version of SWIMS did not have a functional public interface.
- Geographic Information System (GIS) capabilities. The changes to the SWIMS database added GIS mapping capabilities. A significant benefit of this change is that SWIMS is now compatible with databases used by other ADEC programs, which will allow scientists, decision makers, and the public the opportunity to view all of the environmental data available for a given location from one centralized source.
- Inclusion of Waste Index data. This addition allows the SWP to manage and analyze the Waste Index inspection data. The ability to compare the performance of individual landfills to a statewide background will allow the SWP to provide targeted assistance for site-specific and region-specific issues.

IX. Conclusions

The results of the WEAR project demonstrate that there are sites of concern for erosion and contaminant risk. Some landfills, former dumpsites, contaminated sites, and tank farms are at risk of eroding and impacting human health and the environment. The majority of the sites studied do not pose a significant risk of eroding within the next 50 years, if at all. Some of the sites that are expected to erode within the next 50 years do not pose a significant risk to human health and the environmental.

For the 20 sites that received DAPs, the best approach for mitigating risk is unique to the community and the site. Possible mitigation alternatives are provided in the DAPs to help the community decision making. ADEC recommends that communities with sites in danger of imminent erosion take immediate action. For sites where erosion is not expected for decades, continued monitoring is recommended.

The WEAR project and this report, including the DAPs developed for the high risk sites, were developed to assist decision makers, funding agencies, and planners when making decisions on prioritization for response to the impacts of erosion in the WEAR communities.

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Appendices

Appendix A – Preliminary Reports

Appendix B – Detailed Action Plans (DAPs)

Appendix C – Funding

Appendix D – 55 Communities Identified for Inspections

Appendix E – Site Information Form

Appendix F – Pre-Visit Site Survey

Appendix G – Erosion and Contaminant Risk (High risk sites graphed)

Appendix H – Risk Calculator